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ABSTRACT

Because adult basic education (ABE) students often have difficulty with problem solving and comprehension, a study was initiated to determine (1) at what levels of cognitive development ABE students are operating and (2) how teaching materials and methods relate to these cognitive levels. Thirty-two ABE students were given a written test of cognitive development ("How's Your Logic?"), based on Piagetian tasks. Scores were compared with students' scores on the California Test of Adult Basic Education. Materials and methods in use in ABE classes were reviewed with respect to their suitability to the cognitive levels of students. Results indicated a wide range of cognitive developmental levels among the ABE students studied; a disparity between standardized achievement test scores and cognitive levels; and lack of suitability of most materials for students operating at lower levels of cognitive development. Implications are that more research is needed on adult cognitive levels and on whether cognitive development continues into adulthood. More concrete teaching materials and methods are needed for adults at lower levels of development. (Author/CSS)

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PIAGETIAN COGNITIVE LEVELS OF ADULT BASIC EDUCATION STUDENTS RELATED TO TEACHING METHODS AND MATERIALS

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VITA

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ABSTRACT

Adult Basic Education students often have difficulty with problem solving and comprehension. This paper sought to answer the questions: (1) At what levels of cognitive development are A.B.E. students operating? and (2) How do teaching materials and methods relate to these cognitive levels?

Thirty-two A.B.E. students were given a written test of cognitive development, "How's Your Logic?" based on Piagetian tasks. Scores were compared with students' scores on the California Test of Adult Basic Education. Materials and methods in use in A.B.E. classes were reviewed with respect to their suitability to the cognitive levels of students.

Results indicated a wide range of cognitive developmental levels among the A.B.E. students studied; a disparity between standardized achievement test scores and cognitive levels; and lack of suitability of most materials for students operating at lower levels of cognitive development.

Implications are that more research is needed on adult cognitive levels and on whether cognitive development continues into adulthood. More concrete teaching materials and methods are needed for adults at lower levels of development.

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Adult students can be taught to read, write, add, subtract, multiply and divide, but often the attainment of these skills is not accompanied by comprehension and problem solving ability. This is one of the most frustrating aspects of adult basic education instruction.

Study of the literature related to intellectual development, abstract thinking and problem solving revealed the work of Jean Piaget as offering a large portion of the theory and experimentation in that area. His observations of the cognitive development of children seemed to show a structure or hierarchy of problem solving skills: a progression in the acquisition of abstract thinking abilities.

Study of the literature also seemed to show that severe cultural deprivation, cultural differences, emotional problems, and physical and mental handicaps could delay cognitive development, at least into early adulthood. Since Adult Basic Education teachers work primarily with the disadvantaged, those of different cultural backgrounds, and the handicapped, it would seem important for them to be aware of the levels of cognitive development in these students and to adjust teaching methods and

materials accordingly.

The scope of this paper is to determine the various levels of cognitive development that exist within an A.B.E. program, and to analyze the materials and methods presently in use in relation to those levels.

REVIEW OF LITERATURE

Piagetian research with children indicates that in certain cultural groups, and among the disadvantaged and physically handicapped, development is delayed often into late adolescence. G. Gaudia (1972) in a study of American Indian, Negro, and white children found evidence of major differences in rates of acquisition of conservation between racial and social groups. In the rate of acquisition, Negro children (especially older Negro children) performed at a lower level of conservation operativity than Indian and white children. Dasen (1972), referring to earlier studies which showed a slower rate of development among Australian Aborigines, indicates that differences in rate of cognitive development are environmental rather than racial. In a study of Aboriginal children who had been adopted by middle-class Europeans, he found that the rate of cognitive development of these children was almost identical to that of European middle-class children (Mogdil, 1974).

Otaala (1973) attributed the slower rate of development that he found in children of his own tribe to certain tribal customs such as expecting strict obedience from children and discouraging them from asking any questions.

Studies of handicapped children have been interpreted as indicating a slower rate of cognitive development. Nash (1969), Tobin (1972), Hughes (1969) and others have found significantly slower development in visually handicapped children. Furth (1970), Oleron & Herren (1961), and Bradshaw (1964) showed developmental lags of from two to six years in acquiring certain conservation concepts among hearing-impaired children (Mogdil, 1974).

Some studies indicate that cognitive development in the retarded may continue slowly at least into young adulthood. Steele (1975) in a study of students in educable mentally retarded classes (aged 13-16) showed that 26% of his subjects made developmental gains over a period of one year, with most of those moving from preoperational to concrete operational, or moving slowly within the concrete operational stage. Stephens, Miller & McLaughlin (1972) found that

> ...reasoning development proceeded in retardates, ages 16 to 20, although tempo was decelerated...differences continued between the operational thought of normals and retardates. In many instances retardates did not acquire the structures required of concrete logical thought until late adolescence or young adulthood. While the study provided a general indication that young adult retardates <u>continued to make gains in reasoning ability</u>, additional

> longitudinal data...are needed to determine the extent of this growth period (private communication; in Mogdil).

Cross-cultural studies have shown that there are great differences in cognitive development between industrialized and non-industrialized societies. Pierre Dasen concluded that some cultures do not nurture formal thinking at all, and that development is generally slower in those cultures. Research seems to show that in the United States development is slower in the lower classes (Dasen, 1972).

It would seem, then, that the groups most often seen by the Adult Basic Education teacher--the disadvantaged, certain cultural groups, and the mentally and physically handicapped--are the groups most likely to have delayed development.

RESEARCH DESIGN AND METHODOLOGY

Students enrolled in Adult Basic Education classes at Blackhawk Technical Institute were given Gray's test of cognitive development, "How's Your Logic?" Results of this test were compared with students' scores on the California Test of Adult Basic Education. Materials and methods in use in Blackhawk Technical Institute's A.B.E. programs were reviewed to determine their suitability to students' levels of cognitive development.

Description of the Instrument

Through search of the literature and discussions with researchers active in the field, it was determined that no

simple instrument for assessing Piagetian cognitive levels suitable for use by the classroom teacher (one that would not involve extensive training in Piagetian clinical methods) had yet been fully developed and published. The one that was closest to completion was one developed by Gray and others in conjunction with the Biological Sciences Curriculum Study under a National Science Foundation Grant. Gray has been involved for many years in the development of a written test of intellectual development that would be practical for use in schools (Gray 1970, 1973a, 1973b, 1974, 1975, 1976). He has attempted to construct written test items that are logically equivalent to specific tasks developed by Piaget and his collaborators. The instrument "How's Your Logic?" used for this study is a refinement of a prototype Piaget-based written test constructed by Gray and tested on a group of 168 students, aged nine to fifteen in the Centerville, Ohio School District (Gray, 1973b).

The test seemed suitable for Adult Basic Education students. It is designed for easy readability and the instructions specify that the questions are to be read aloud to the students as well. Concrete operational questions have pictures to clarify their meaning. Questions and pictures are on a fairly adult level in content.

The test consists of thirteen questions designed to assess different types of logic. Question eleven, for example, which tests the logical multiplication of classes--many-to-one correspondence between a class with several members and a class with one member--states:

A football coach has seven quarterbacks, Bob (B), Dick (D), John (J), Lou (L), Ken (K), Mike (M), Tim (T), and one wide receiver, Nick (N). The coach wants to find the best quarterback-wide receiver pair. Write all the possible pairs of quarterback and wide receiver if each quarterback passed to the wide receiver. Use the first letter of each person's name in your answer.

The question is accompanied by pictures of the seven quarterbacks and the wide receiver with the name of each printed under the picture. Table 1 shows the types of logic tested by each question.

Gray attempted to establish the validity of his written test by comparing the performance on the traditional Piagetian tasks. The results were only partially successful, with some items on the written test comparing "perfectly" with their equivalents in the Piagetian tasks, and others, particularly those involving proportional reasoning, comparing quite poorly. The "How's Your Logic?" instrument is an attempt to correct the inadequacies of the prototype and, although still in the experimental stage at the time of this writing, was, according to Gray, "lining up exactly as Piaget says they (the test items) should."

Two versions of the instrument have been developed. Gray and his associates have given both versions to their subjects

TABLE I

Question Number	Description of Logic
1	Addition of asymmetrical relations: establishing an increasing series.
2	Hypothetical-deductive thinking: make correct implication.
3	Explanation of Hypothetical-deductive thinking: making corrective implication.
4	Addition of asymmetrical relations establishing a decreasing series.
5	Combinatorial thinking: systematic generation of a complete set of combinations.
6	Combinatorial thinking: systematic generation of all possible permutations.
7	Logical multiplication of classes: establishing one-to-one correspondence between each element of one class and each element of a second class.
8	Logical multiplication of relations: establishing an increasing series (horizontal) and a decreasing series (vertical) where the elements intersect.
9	Hypothetical deductive thinking: deny incorrect implications.
10	Explanation of hypothetical-deductive thinking: deny incorrect implications.
11	Logical multiplication of classes: many-to-one correspondence between a class with several members and a class with one member.
12	Proportional reasoning.
13	Explanation of proportional reasoning.

and have found that the items designed to test the same types of reasoning correspond.

Thirty-two Adult Basic Education students were tested. Twenty-four of these were students who suffer from mental, physical, or emotional handicaps. Eight were primarily disadvantaged or educationally deprived. Students ranged in age from 18 to 65.

Administration and Scoring of Tests

Tests were administered to the students in their respective Adult Basic Education classrooms by their teachers. Questions were read aloud and, where necessary (because of physical handicaps or because student had not learned to write), teachers wrote in the answers dictated by students. Students were given as much time as necessary to complete the tests.

The completed tests were sent to Gray for scoring. Each question was given a numerical score indicating the level of cognitive development shown by the student's answer to that question. A student's level of development was determined to be preoperational, concrete operational, or formal operational if he had at least 75% of the items correct at his highest level.

Limitations of the Study

Conclusions derived from this study are limited to this particular sample. The sample is not random, nor is it necessarily representative of all Adult Basic Education students.

Another limitation of this study is the fact that the test

instrument, "How's Your Logic?" is still in the experimental stage and may still have some problems. Another limitation was that the computerized scoring program which was to have been used to score the tests had not been completed at the time of this writing, so the tests had to be scored by hand. As a result students' cognitive levels were given in only the three broad categories of Preoperational, Concrete Operational, and Formal Operational. The computerized program would have given a more precise breakdown into sub-categories. There would seem to be a great difference in ability between a person at the beginning of each developmental level and one at the transitional stage to the next level.

RESULTS

Results of the test "How's Your Logic?" showed students' developmental levels to be quite consistent with their classroom performance in the areas of comprehension and problem solving, but in some cases quite inconsistent with their scores on the standardized achievement test, The California Test of Adult Basic Education (T.A.B.E.). This helped to explain the difficulties some students had been having with comprehension. No student was found to be operating consistently at the level of formal operations, and many were functioning at the preoperational and beginning concrete operational levels. Table 2 shows students' developmental levels compared to their achievement levels.

Table 2

Cognitive Levels of Students Compared To Achievement Test Scores

Subject	Developmental Level	T.A.B.E. Grade Levels Reading	Math
HC	Preoperational	0.0	0.0
JP	Preoperational	0.0	1.5
CK	Preoperational	1.0	1.0
WR	Preoperational	1.9	2.9
VD	Preoperational	2.5	2.0
CL	Preoperational	2.8	4.0
HM	Preoperational	2.9	4.5
TB	Preoperational	3.8	4.8
DM	Preoperational	4.4	4.0
HA	Preoperational	4.7	4.5
SL	Preoperational	4.1	4.8
SC	Preoperational	5.2	5.0
FG	Preoperational	5.3	5.2
SS	Preoperational	6.2	6.1
EB	Preoperational	6.5	7.1
PO	Preoperational	7.7	7.0
VC	Preoperational	9.8	7.0
JD	Concrete Operational	4.3	4.8
MP	Concrete Operational	4.8	5.8
KH	Concrete Operational	6.2	8.0
DL	Concrete Operational	7.0	7.5
HD	Concrete Operational	7.4	6.9
CS	Concrete Operational	7.6	6.9
FD	Concrete Operational	7.7	6.9
LL	Concrete Operational	7.7	7.5
HC	Concrete Operational	8.3	6.9
CA	Concrete Operational	8.9	9.4
GB	Concrete Operational	9.0	8.2
WP	Concrete Operational	9.5	8.1
SW	Concrete Operational	10.5	8.4
HM	Concrete Operational	not available	
PS	Concrete Operational	not available	

Examination of Teaching Materials and Methods

Materials and programs of the major Adult Basic Education publishing houses such as Mott, Steck-Vaughn, and Laubach were reviewed in light of their suitability to the developmental levels of students. Workbooks, even at the beginning levels, were found to have very few pictures, perhaps in keeping with what is felt to be a more adult image. Lack of pictures, however, makes many of the exercises entirely verbal: a level of abstraction impossible for the person in preoperational or early concrete operations stages. The Mott workbooks, for example, in an effort to teach and use words having the same word patterns and sounds, are forced to construct sentences and stories that have little meaning or interest. They use words not often used in everyday conversation, or use ordinary words in unusual contexts. Sentences are often unnecessarily long and complex: i.e., "She squinted in the light of the lamp held in the hand of the man stepping over the threshold." (Mott, 300A, p. 42). This sentence is contained in a story about Betsy Ross. In order to understand the story, the reader must bring to it a knowledge of American history and have the formal operational skills of inference and interpretation.

Math workbooks seemed to assume that the adult learner had already developed the concepts of seriation, ordering, matching, classification, reversal, time, speed and distance; and that it only remained to teach the math skills necessary to solve problems involving these concepts.

Adult Basic Education teachers were found to be relying primarily on programmed materials and individualized instruction as their classroom method. Some attempts had been made at small group discussion, but teachers reported that students were unwilling to participate; that students did not seem to have opinions to express (an indication of a preoperational or pre-logical developmental level). Another problem was the difficulty of getting people at the same level together at the same time.

DISCUSSION

More than half of the students tested seem to be thinking at the preoperational or prelogical level. This means that these students are likely to find it difficult or impossible to follow sequences of events, to "reverse" mentally, to "conserve" more than one aspect of a substance at the same time or to have developed concepts of classification, seriation, time, speed, or distance. Such students have difficulty telling the sequence of events in a story, even though they may have a good reading vocabulary. They may be able to learn basic arithmetic skills, but will not understand how to apply them in everyday situations. They will have difficulty learning to tell time, count money, or measure. They may not be able to participate meaningfully in class discussions.

The rest of the students seem to be thinking primarily at the level of concrete operations, although some of them may occasionally use formal operational structures. These students

may not have developed the structures to be able to understand ratio and proportion problems, to be able to follow the form of grammatical constructions or logical arguments, or to be able to learn more advanced comprehension and mathematical skills.

These results may be interpreted to mean that some students may be able to achieve fairly high reading and math levels, as measured by standardized achievement tests, without having developed the cognitive structures necessary for comprehension and problem solving. Memory and rote learning may enable a person to pass tests, but not be able to solve everyday problems. An example is subject VC, who according to Gray's test is functioning at the preoperational level. This student had passed the high school equivalency tests. He was referred to a rehabilitation center for work adjustment training because he was unable to keep a job, and was subsequently referred to A.B.E. classes because he was unable to follow written directions or solve simple consumer problems such as adding up a list of prices and then subtracting from the amount given to figure change.

The poor comprehension and inability to solve problems of other students was explained by their apparently low level of cognitive development. Subject PO, with a seventh grade level on the T.A.B.E., is an elderly woman who did not go beyond eighth grade, but always wanted to finish high school. Although she seemed to have retained most of what she learned in childhood, she has little capability of learning new material. This might be due to her preoperational level of development.

Subject CA, whose scores on "How's Your Logic?" indicate beginning concrete operations, has T.A.B.E. scores of 8.9 in reading and 9.4 in math: good scores for a high school dropout. His spoken expression and reading vocabulary are very good. One might think his only handicap was physical; but his comprehension is very poor. He has had special difficulty with concepts of measurement and geography. Could this be because he is on crutches and cannot move about easily? Having been handicapped since birth, his sensori-motor development may have been impeded.

Subject MP, on the other hand, has relatively low scores on the T.A.B.E. (4.8 in reading and 5.8 in math), but her scores on Gray's test indicate a fairly high concrete operations level. She is a woman in her mid-twenties who was labeled TMR (trainable mentally retarded) and did not go beyond fourth grade because of a lack of programs in special education at that time. She has speech and hearing impairments and a very poor self-image, which seem to hamper her ability to learn; but she has problem-solving abilities beyond what one would expect of a TMR individual. She learned to count money and figure change; to add up a list of prices and subtract from the amount given to figure change; to find total wages, given hourly rate and number of hours worked. Perhaps she was mis-labeled TMR in the first place; or perhaps she is one of those retarded individuals whose development has continued into adulthood.

Materials and methods most commonly used in Adult Basic

Education programs seemed to assume at least concrete operational levels of development on the part of the student, and sometimes even higher levels. Workbooks that lack pictures, that use complex sentence structure for beginning readers, that require formal levels of comprehension, are difficult if not impossible for students with preoperational or beginning concrete operational levels of development. It would seem safe to say that the majority of students in A.B.E. programs in this country who are at the very beginning levels of reading and math suffer from some sort of learning handicap; and that handicap may be that they have not developed the cognitive structures necessary to process abstract information. Materials and methods presently in use do not seem to meet the needs of these students.

CONCLUSIONS AND IMPLICATIONS FOR FURTHER STUDY

Results of the test "How's Your Logic?" indicate that there is a wide range of cognitive developmental levels among the Adult Basic Education students studied. It would seem likely that a similar range of developmental levels exists among other Adult Basic Education students.

The disparity between grade levels as determined by the California Test of Adult Basic Education and the developmental levels shown by "How's Your Logic?" would seem to suggest that standardized tests of this type are not sufficient to assess reasoning abilities of students. Diagnostic tests are needed that would indicate whether the student understands concepts such as classification, seriation, sequencing, time, distance,

etc., since these concepts are prerequisite to any real learning of mathematics or comprehension of reading.

Adult Basic Education materials seem to be designed for the "normal" adult who has reached the formal level of development but who has not had the opportunity for education. Test results might be interpreted to indicate that such a person is relatively rare in A.B.E. classes. A.B.E. materials more appropriate to adult students at lower levels of development are needed. Such materials would include more pictures and "hands-on" tasks, without seeming childish. Teachers might make more use of role-playing, dialogue, and language experience methods.

The question of whether it is possible to promote cognitive development through education has not been addressed in this study but is one that requires serious consideration. Furth and Wachs (1974) have developed an educational system using Piaget's theories which they call "A School for Thinking." Their school stresses the development of thinking skills rather than the usual subject matter of reading, writing, and arithmetic. Whether their system actually promotes cognitive development, and whether their methods would be applicable to Adult Basic Education classes has yet to be explored.

Another area that needs to be explored is whether cognitive development continues in adulthood among slow learners and disadvantaged groups. Steele indicates that there is a very slow growth in cognitive development in retardates in their late teens, and that as many as forty percent of these children may have been placed in special classes for reasons other than

retardation. Stephens, Miller & McLaughlin found that reasoning development proceeded in retardates aged 16 to 20 (Mogdil). If cognitive development does continue into adulthood, it might mean that some people who were unable to learn during the usual school years might be able to benefit from education at a later age. Longitudinal studies of adult cognitive development need to be done.

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